Online Social Reference: A Research Agenda Through a STIN Framework

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ABSTRACT

This paper suggests a research agenda for online social reference using the Socio-Technical Interaction Network (STIN) framework [21]. It addresses the need for more research on social reference, which refers to online question asking and answering services that are provided by communities of volunteers on Q&A sites. Social reference exemplifies an interesting stage of development in two information research domains: 1) information retrieval, as it combines social input into the technological challenges; 2) reference research, as it signifies a group collaborative efforts to answer questions instead of the traditional dyadic question negotiation. The proposed research agenda draws from social informatics and suggests questions that address both the social and technological factors at work on Q&A sites.

Categories and Subject Descriptors

K.4.m. [**Social Issues**]: Miscellaneous.

General Terms

Theory.

Keywords

Social Reference, Q&A Sites, Web 2.0, STIN, Socio-technical Interaction Network, Social Informatics.

1. INTRODUCTION

As a result of the growth of Web 2.0 and its participatory social sites, such as Flickr, YouTube, Wikipedia, and Yahoo! Answers, along with the spread of ideas such as the wisdom of the crowd [32], many traditional conceptions of information creation, dissemination, and use are being challenged. One increasingly popular type of web 2.0 application is the question and answer (Q&A) site. The increase in the popularity of these sites is remarkable; from 2006 to 2008, the number of visits to the top five Q&A sites increased by 889 percent [13]. The largest among these sites, Yahoo! Answers, includes over 23 million resolved questions and over 100 million users [1, 7]. Yahoo! Answers, attracts the greatest number of visits, with 74% percent of the market share of U.S. visits; WikiAnswers is second with 18% and Answerbag is third with 4% of visits [13]. Hitwise [13] also reports that the majority of the visitors to these sites are female (52%), and most are users between the ages of 35-44 (24%), and 25-34 (21% percent).

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While online social reference is flourishing, research on Q&A sites is in its infancy. Because Yahoo! Answers is the most popular Q&A site it has been the focus of the majority of these studies [1, 2, 4, 7]; only a few have looked at other Q&A sites, such as Answerbag, Google Answers, and the Wikipedia Reference Desk [9, 10, 12, 30]. The research on Yahoo! Answers mainly addresses questions in the domain of information retrieval and seeks to identify high quality answers in order to facilitate the automatic prediction of best answers [e.g., 2. 4, 7]. The identification of best answers is crucial because answer quality varies on each of these sites. Likewise, the quality of service varies from one site to another [12, 26]; in fact, some sites provide better services than libraries do [12, 30].

An examination of the literature on online social reference indicates that researchers have not yet unpacked the black box of the processes that characterize Q&A sites. While the research is driven by questions and theories in the domain of information retrieval [31], the interaction among members of the community is largely being neglected. Likewise, online social reference has not been examined in the context of larger societal or even industry trends. It is possible that this is partially due to the fact that online social reference is a relatively new phenomenon and because of the assumption that existing knowledge and theories about traditional reference activities can be used here. There is a need to address online social reference from a critical point of view to gain a better understanding of the socio-political environment of Q&A sites. This analysis will inform future researchers, and will suggest implications for system designers, policy makers, and information professionals. As will be argued below, the Socio-Technical Interaction Network (STIN) framework, a theoretical extension of social informatics, in particular, can be useful here because it provides a systematic, sociotechnically-oriented model to study this phenomenon, accounting for the technological and social systems and their intertwined interactions in the routine use of technologies [21].

Some questions from a social informatics point of view that can be useful here are: What are the social, technical, and organizational factors that shape successful and unsuccessful services? How do participant communities develop over time? How do leadership, motivation, conflict resolution, and norms of behavior play a role in the question answering processes? In what ways do the technologies that support online social reference, shape the social worlds that they make possible? How do these technologies affect the social interactions that take place in these

communities? How do the participants shape the technologies they use?

2. SOCIAL REFERENCE

What is online social reference and why is it an interesting phenomenon to investigate?

2.1 What is Social Reference?

Social reference refers to online question answering services that are provided by communities of volunteers on Q&A sites. In addition to Yahoo! Answers, other examples of Q&A sites include Wiki Answers (a user-driven Q&A component of Answers.com), Askville (Amazon's question answering service), Answerbag (the first social reference site) and the Wikipedia Reference Desk (where Wikipedia volunteers answer questions). It does not refer to fee based online question answering services (e.g., Google Answers, which has recently discontinued its operation), services on which only a few users can answer (e.g., ChaCha, libraries, AllExpert), or e-services of businesses provided for their own clients.

Social reference is a participatory, online group collaborative effort that utilizes wikis and blogs to answer questions. Boundaries between users, who ask, and those who answer, are blurred in social reference; power is decentralized, users are empowered and power distance is minimized. This is especially the case when these are compared to institutionalized questions answering services that professional reference librarians provide [30]. While in the institutionalized setting there is a clear power distance and role separation between service providers and costumers, on Q&A sites, users can serve on dual roles (asking and answering) and in that manner the boundaries between those who ask and those who answer are blurred. Users participate in various roles on these sites: askers, answerers, and evaluators [4], or consumers who ask and contributors who answer [31]. About one fifth of the users participate in dual roles on Q&A sites, asking and responding to questions [1, 30], but a few highly active users on each of these sites only answer questions and do not ask many [1, 30, 31, 33]. Furthermore, on Q&A sites a bottom up approach is encouraged, in categorizing and answering questions, evaluating questions and answers, and defining, contributing, and implementing the site's policies and guidelines (a good example is the Wikipedia Reference Desk Guidelines).

Any question that is posted on a Q&A site is categorized under broad topical categories. Users can categorize and re-categorize questions and on some of these sites (for example, Answerbag, Askville, and Yahoo! Answers) they can rank their questions as well. They can also answer questions that have been posted. On average, more than two answers are submitted per question by volunteers [12, 31]; on Yahoo! Answers and the Wikipedia Reference Desk four or more responses, on average, are submitted per question [12, 30]. On Askville, a question can receive up to five answers and users can discuss the question in designated areas. Users who provide answers can simply answer the question, or they can elaborate, modify, clarify, or contradict previous answers. Because answer quality can vary, some of the sites enable users to determine which of the answers on a given question is the best (Yahoo! Answers, Askville, Answerbag). In addition, and because some users provide better answers than others, a few of the Q&A sites employ a user reputation system (for example, Yahoo! Answers, Answerbag, and WikiAnswers).

2.2 What do we know about Social Reference?

The major motivation of the research on Q&A sites is to improve retrieval of previously answered questions and to facilitate an automatic identification of high quality answers. One approach used to evaluate answer quality is through an examination of user reputation [6]. Variations on this approach have dominated the research on Q&A sites and have mostly tried to identify users who are expected to submit high quality answers that are more likely to be chosen as best answers. For example, researchers examined user contributions across topical areas. Answers by users who are active only on specific topics are better than those provided by users who participate on multiple categories in areas that require factual expertise [1]. Prediction of answerer credibility, based on the number of best answers the user had previously submitted was the focus of a study by Dom and Paranjpe [7]. Their calculations took into account the number of answers the user submitted, as well as the overall population statistics and those of the specific user. Similarly, Jurczyk and Agichtein [16, 17] used link analysis to identify authoritative answerers and rank them. Researchers developed an automatic method to identify high quality questions and answers that aimed to be as accurate as users' identifications of best answers [1]. Their automatic identification of quality is based on: 1) intrinsic content quality (quality of the content of each answer): punctuation and typographical errors, syntactic and semantic complexity, and grammar; 2) user relationship through link analysis; and 3) usage statistics.

Other measures of high quality answers were examined, besides the efforts to identify users who are more likely to provide better answers. The strongest predictor of answer quality, in questions with multiple answers, was the length of the answer [1, 12]; best answers are longer than non-best answers. Also, answers that included references to external sources were of higher quality than those who did not make such references [9] and the number of links was significantly correlated with high quality answers [12].

Very little attention has been paid to the social dimension of the Q&A community or to the users of these Q&A sites. Gazan [10], for example, identified two types of askers on Answerbag, the seekers and the sloths. Seekers, who interact with the community, receive more responses to their questions than do sloths. In another study, he identified two types of answerers, the specialists, who do not use external references, and the synthesists, who refer to external sources [9]. The answers of synthesists were ranked more highly than were those of specialists on the Answerbag portal. User participation behaviors revealed that users who are more active participants are more likely to provide answers than to ask questions and more likely to have answers that are chosen as best answers than less active users [31].

From this brief review of the literature on online social reference, it is clear that most researchers have taken an economic, rational, and somewhat deterministic approach to user behaviors, motivations, and interactions. This approach is not surprising as most of the studies are aimed at improving the system from an engineering point of view. The research focuses mostly on input and output measures and almost completely ignores the social processes and the nature of interactions among users on these sites. There is a need to unpack this black box, and to try to understand the process and outcomes that characterize Q&A sites, to challenge the deterministic rational assumptions, to look more

closely at the socio-political processes on these sites, and to identify the motivations and actions of winners and losers in the context of these sites.

2.3 Why Study Social Reference?

There are several reasons why online social reference is an interesting phenomenon to study. From an information science perspective it exemplifies the appearance of a new phenomenon in two domains: information retrieval and reference research.

First, for information retrieval researchers, social reference adds collective human answers and relevance rankings as an integral part of the creation of a repository of hundreds of millions of humanly generated answers to previously asked questions [4]. Effective retrieval of (the best) answers from these repositories is critical, especially since answer quality varies significantly. Furthermore, because the content on Q&A sites differs from traditional web content in quality and style while supporting innovative online social interactions, social reference requires "new techniques for analyzing and retrieving relevant content" [4, p. 467]. Since online social reference includes users responses, comments and discussions, as well as users' ranking of questions, answers, and other users, retrieval mechanisms should integrate social interactions and user feedback [2, 4, 7, 16, 17].

Second, for reference researchers, online social reference exemplifies a new stage in question asking and answering. This new stage involves a transition from a dyadic question negotiation to a collaborative group effort and a technological change. Traditional reference is perceived as the antecedent of online social reference [10, 12, 30]. In recent years, the utilization of Web 2.0 technologies has facilitated the growth of Q&A sites that, in turn, has enabled these sites to capitalize on mass collaborative user participation; these technologies and this social activity have also enabled the development of new business models, such as those of Google Answers (that has ceased operation) and ChaCha. Questions about cost-benefit, economic viability and sustainability, answer quality, and service effectiveness are more critical than ever and should be systematically addressed. Answer and service quality varies between Q&A sites [5, 12, 26, 30]. Hence, social reference effectiveness should be examined, quality measures should be clearly determined, and theoretical models should be identified, modified, or developed in order to explain, analyze, predict, and evaluate the performance of Q&A sites.

Moreover, the research on online social reference is scarce; despite the popularity of Q&A sites among users, they have attracted little research attention and have been almost ignored in mass media. Q&A sites attract millions of visitors each month; the Yahoo! Answers site alone receives as many daily hits as flickr [27]. It is possible that the lack of research and media interest in Q&A sites is partially due to the sites' user demographics, which are composed mostly of teenagers and stay at home moms [11]. While these Q&A sites capitalize on the wisdom of the crowd, as do other web 2.0 sites, they differ from them in that they are female dominated [13]. As such, it is likely that patterns of interaction and norms of communication on Q&A sites will differ from those that characterize sites like Wikipedia; valid extrapolation from this body of knowledge to explain behaviors on Q&A sites is questionable.

Above all, it is clear that the human and the technological components cannot be meaningfully separated from each other in any analysis of Q&A sites, under the information retrieval or reference research domains. Q&A sites, along with other Web 2.0 sites, could possibly threaten the continuation of traditional cultural institutions [18], such as libraries, if they can provide the same services to users at lower costs. Research is needed to understand these sites in a larger socio-political context, with various stakeholders' interests and motivations taken into account. Technological determinism should be replaced by approaches that assume an intertwined relationship between the technological systems and the social factors; towards this end, the STIN approach [21] is discussed below as promising alternative.

3. STIN: A SOCIO-TECHNICAL INTERACTION NETWORK

3.1 What Is A STIN?

A socio-technical interaction network (STIN) is a conceptual model and a framework for understanding complex networks of people, ICTs, organizations, and their structured interrelationships. The STIN model was developed by Kling and colleagues [19, 20, 21] to extend the theoretical reach of social informatics (SI), which studies the design, uses, and implications of ICTs in ways that take into account their interactions with their social and cultural contexts [22]. The socio-technical interaction network has since been used to study collaboratories [19] scholarly communication forums and scientific epublishing [19, 21, 24], communication regimes in digital photography [25] web information systems [8], digital libraries [28] and the free and open source software movement [29]. Scacchi [29, p. 2] argues that a STIN framework is useful "for identifying, organizing, and comparatively analyzing patterns of social interaction, system development, and the configuration of components that constitute an information system." This paper suggests that the STIN framework can be usefully applied to the investigation of Q&A sites and online social reference. The STIN model has its origins in the social construction of technology approach and actor-network theory (ANT), sharing some epistemological assumptions (see [23] for an analysis of the connections among these approaches). Kling et al. [21; 48] define a STIN as:

> A network that includes people (including organizations), equipment, data, diverse resources (money, skill, status), documents and messages, legal arrangements and enforcement mechanisms, and resource flows. The elements of a STIN are heterogeneous. The network relationships between these elements include: social, economic, and political interactions.

Kling and colleagues [19, 20, 21] originally proposed the STIN model in order to understand networked scientific phenomena. With this tool, they investigated various aspects of collaboratories and scientific epublishing such as the conditions, activities, and social behaviors supporting these phenomena and the working relationships that influence and shape their development and operation. Kling, et al [21; 1] quickly saw that the framework had wider applicability arguing that it could "help explain the sustainability, or conversely, the failure of collaboration within collaborative systems" and direct research attention towards "more integrated conceptions of the interaction of people and technologies." According to Kling, McKim and King [21; 48] "the insights from STINs can also be extended to other electronic communication forums … STIN models help us to understand human behaviors in the use of technology-mediated social

settings". Online social reference in Q&A sites is one such collaborative technology-mediated setting.

The STIN framework assumes that a network can be best understood through the processes (rather than results) of social interactions among its heterogeneous components. In particular, "participants are embedded in multiple, overlapping, and non-technologically mediated social relationships, and therefore may have multiple, often conflicting, commitments" [20; 57]. A value of the STIN approach is that it "looks beyond the socio-technical system under study and also examines how other portions of an actor's social world are connected to their use and understanding of technology" [23; 39]. It assumes a relationship of mutual shaping where "technology-in-use and the social world are viewed as coconstitutive" [3; 237], meaning that researchers can explain and understand information systems through social and cultural contexts and bi-directional relationships.

The STIN framework focuses research attention on the complex interactions among the heterogeneous human and non-human participants involved in the design, use, and operation of networked digital phenomena such as online social reference systems. To set the boundaries of the STIN requires making decisions about what is inside and what is outside of the network. Kling, McKim and King [21; 54] argue that two main categories of social interaction can be seen as "generative of" a STIN. The first, resource dependencies, includes relationships through which needed resources flow into the network and through which people are able to use the ICTs in the network. The second, account-taking, includes relationships through which discourses about the network are created and disseminated, linking actors to others who serve as "reference points."

3.2 How can the STIN Framework Help

In short, the STIN framework can inform and deepen research about online social reference and extend the applicability of the framework into the Web 2.0 environment.

If online social reference is considered as an ICT-based network within which heterogeneous components interact, it can be described as a STIN. In the same way as other networks, online social reference systems are constituted out of heterogeneous components, which include human resources (participants including question posers, question answerers, answers and questions evaluators, readers, system moderators, system technicians, advertisers, and others) non-human resources (technologies, funding, digital collections, status of the host organization, norms, and rules), the contexts of resources and of the parent organization, as well as the social, political, and economic relationships among these resources. From the standpoint of a STIN framework, the design, implementation, operation, maintenance, and uses of Q&A sites are affected by interactions among these heterogeneous components [15].

Many kinds of ICTs used in developing and operating online social reference services are also shaped by social and organizational contexts. One important context is that of the people who participate in these services. They have different educational backgrounds, different intellectual and social histories and levels of technical experience, different technological configurations used to access the service, and different abilities to search for, find, evaluate, and make use of information. These users' contexts influence how and why they use information, what kinds of information they use, and the results of their use of information. That is, the processes and results of the introduction of ICTs in online social reference services are interrelated with users' contexts. The interactions among people using the online social reference service, their cultural contexts, and the ICTs they use unfold within a web based information system and also in a much broader social space that includes the institutional and cultural environments of the societies in which the online social reference services are constructed and operated. Within these environments ICTs for social reference and their various contexts and users are tightly interwoven.

As a STIN, a Q&A site includes actors (individuals, groups, organizations, and institutions), ICTs, and relations of dependency among them. The design, implementation and maintenance of the system, as well as its configurability, are impacted by the actions of and interactions among these actors. Because mutual shaping is a key process in STINs, the relationships, interactions and practices of actors are shaped by their uses of ICTs. For example, Yahoo! Answers, and Answerbag sites are designed to increase users' active participation through the posting of users' contributions, and their levels on their profiles. Although a user's reputation on each of these Q&A sites is based on a different set of criteria, both utilize this information to create competition among users, which increases participation in the specific community. These mechanisms may partially explain the high rate of repeat visits to the top 5 Q&A sites (almost 50% of the visits) [13]. On the Wikipedia Reference Desk, this mechanism is not part of a structured user page; users can design their own user pages, and their contributions to the Wikipedia Reference Desk are only part of their activities on Wikipedia. The factors that determine user reputation and status on the Wikipedia Reference Desk is based on contributions made to the Wikipedia project in general (e.g., Bureaucrats) and not to the Q&A segment of the project. While on Yahoo! Answers and Answerbag, recognized users have their status revealed through various symbols and ranks on their user pages, on the Wikipedia Reference Desk, the symbols and status ranks are those of the larger Wikipedia community. These differences may reflect the variations in the structures of these communities; Wikipedia with a bottom up approach, that empowers users to design their own user pages, compared with Yahoo! Answers and Answerbag, that implement a top down a system where user pages are structured, and where users can only partially modify their user pages in designated areas. Furthermore, this example illustrates clearly the ways in which technology in use and systems are co-constitutive, how actors (users and institutions) and technologies are engaged in relations of dependency and mutual shaping.

Research about STINs has focused mainly on the interactions among components needed to construct networks, but it has not studied deeply what leads to the interactions in the STIN. According to Eschenfelder and Chase, [8; 5] this next step is useful because "social components comprise an integral part of the technological system, and by providing examples of how social forces shape the technical components of the system," the bases of interactions can be uncovered. By studying online social reference systems and the interactions that take place within them, it becomes possible to analyze them within larger and more complex contexts than merely the question and answering interaction. For example, there are certain social reference sites that have clearly awakened the interest of potential users, draw these people to them, and then facilitate the achievement of their

objectives [14]; within a STIN framework (via ANT) these are "enrollment strategies" [28]. By observing the extent to which participants have made use of enrollment strategies during the development and operation of a social reference site, it becomes possible to explain how these strategies enable and maintain this type of STIN. In addition, this type of study would show how the STIN alters the existing relationships between information and users, staff and users, and users and users in the process of the interaction. This can be particularly useful given the nature of Q&A sites in a Web 2.0 environment, where the mass collaborative effort of knowledge production and use is a routine form of social interaction that supports and maintains these sites.

From a social informatics perspective, it has become clear that there is often much more socio-technical complexity to many digital spaces than is often realized [22], and online social reference is no exception. Socio-technical complexity means that ICTs are not isolated from the society of which they are a part, and, in fact, there is a strong bi-directional relationship between society and technology. In this sense, the STIN approach is "particularly useful for understanding the mutual shaping between technology and social context and the consequences of ICT use" [8, p. 5].

4. A RESEARCH AGENDA FOR SOCIAL REFERENCE BASED ON THE STIN FRAMEWORK

Research on social reference can be broadened and deepened by employing a social informatics perspective and a STIN framework. Ongoing efforts to determine the characteristics that generate high quality answers is useful since they may lead to automated question answering systems. However, as has been argued above, there are many additional interesting questions to ask about social reference than those posed from an information retrieval standpoint. By adopting a social informatics perspective, it is possible to move beyond instrumental questions about social reference (assessing the quality of answers to improve predictive power of service) to understanding Q&A sites in their social and organizational contexts.

Treating social reference as a STIN means attending to a particular set of elements including [23]:

- People in various social roles with each other and with system elements
- Support resources (training/support/help)
- Information structures (content and content providers, rules/norms/regulations including those that authorize people to use information and systems in specific ways and those involving access controls)
- The network's content for various constituencies, who is authorized to change the content, and how that matters

Given the brevity of this paper, only a sketch of a research plan will be provided based on the steps identified to conduct research on a STIN, provided by [21]:

1. Identify a relevant population of system interactors
2. Identify core interactor groups
3. Identify incentives
4. Identify excluded actors and undesired interactions
5. Identify existing communication forums
6. Identify resource flows
7. Identify system architectural choice points
8. Map architectural choice points to socio-technical characteristics.

The STIN approach seems apposite in an environment where there is increasing competition among Q&A site providers, increasing amounts of capital invested in these services, and at least one service, Google Answers, that has already ended operations. Research using a STIN framework can describe and analyze the distinct human and technological components that have to work together in some way, and the relationships of these components with their socio-political contexts. It should focus on the groups of technical and non-technical stakeholders some of whom have an interest in the success of the service and some of whom may not. A STIN framework leads to a range of interesting questions about Q&A sites and online social reference systems:

- How do these services work? What are the business models that drive them? What are their roles in their host organizations? What are the social, technical, and organizational factors that shape successful and unsuccessful services?
- Who are the key stakeholders involved in social reference on Q&A sites? Who are the winners and losers when these sites succeed? When they fail? How do participant communities develop over time? How do leadership, motivation, conflict resolution, and norms of behavior play a role in the question answering processes? How does boundary crossing occur?
- What are the limitations of these sites? What are the possible damages that can result from further popularity of Q&A services? To what extent do these sites exemplify the paradox of expertise, and what are the consequences of this phenomenon for the future of libraries, and possibly other cultural institutions?
- Do underrepresented groups benefit from Q&A sites? If so, how and in what ways? If not, why not? Can evidence of benefits and costs to these groups be identified?
- How do Q&A sites differ from each other? To what extent they complement each other or overlap with each other?
- How do libraries' reference services and Q&A sites differ, complement, or overlap with each other? How do library reference services compared in quality to Q&A sites? How do Q&A sites compare to other Web 2.0 sites (e.g., Wikipedia, especially given the fact that they differ in their user demographics)?
- What are the motivations that drive user contributions on these Q&A sites? How are these motivations compared to those of users on other Web 2.0 sites (e.g., Wikipedia), and to reference librarians?

Investigating each of these questions might require the use of different research designs, a variety of methods for data collection and data analysis, the discussion of which is beyond the scope of this brief paper.

5. CONCLUSION

An analysis of Q&A sites from a social informatics approach, using the STIN framework will not only contribute to the study of social reference, but will also enable the extension of the STIN framework into Web 2.0 environment. We hope to report on the preliminary results of an investigation of online social reference services using a STIN framework at next year's iConference.

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